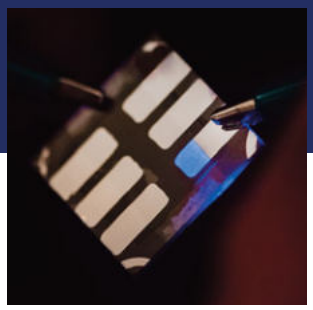
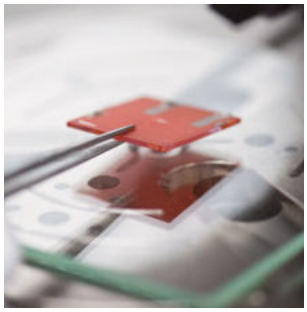
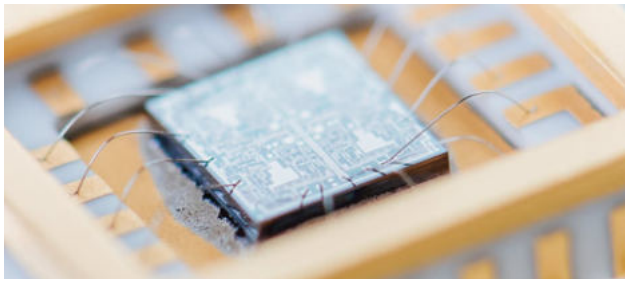
The Excellence Centre of Advanced Material Research and Technology Transfer





INSTITUTE OF SOLID STATE PHYSICS
UNIVERSITY OF LATVIA

CAMART²

SCITECH EUROPA LOOKS AT THE TEAMING INSTRUMENT, FOCUSING IN ONE OF THE PROJECTS TO RECEIVE FUNDING UNDER THE WIDESPREAD-1-2014 CALL, CAMART^2

TEAMING up

IN 2015, the European Commission announced it would be providing new grants to help bridge the research excellence gap between member states and strengthen competitiveness and growth across Europe. This was to be done via the new Teaming instrument, which was designed to help improve research performance and increase investment in countries with lower research excellence rankings.

With funding from Horizon 2020, 31 projects from such countries were selected to prepare operational plans for new centres of excellence by teaming up with high-calibre institutions from all over Europe. The first Teaming projects selected for funding were led by research institutions or agencies as well as national or regional authorities, and phase one of this action saw projects receive up to €500,000 each (€14.5m in total) to prepare operational plans for new centres of excellence or for upgrading existing ones.

Speaking at the time, European Commissioner for Research, Science and Innovation Carlos Moedas said: "Put simply, we want Horizon 2020 funds to benefit as wide a range of European universities and research institutes as possible. We are determined to see that no part of Europe is left behind in research and innovation. Teaming now helps to achieve this by creating partnerships between those at the top and those with the most potential. Horizon 2020 rewards excellence and, most importantly, the pursuit of excellence."

In phase two, up to ten of these projects could then be selected for further support to implement the centre, following a competitive review process. The funding for the first step proposals (31 selected out of 169 submitted) reached €14.5m and around €87m was, in 2015, foreseen for phase two.

Carlos Moedas (Commissioner of Research, Science and Innovation)

Under Horizon 2020, the commission has said, a strong packet of measures with up to €800m was made available for widening participation of low-research performing member states. Such actions include Teaming, Twinning (institutional networking that includes support on staff exchanges, expert advice and assistance), as well as special awards like the new ERA Chairs instrument.

Widespread

Outlining the 'WIDESPREAD-1-2014' Teaming topic, the Commission has explained that 'Despite its strengths, the European Research and Innovation landscape presents a lot of structural disparities, with research and innovation excellence concentrated in a few geographical zones. These disparities are due to, among other reasons, the insufficient critical mass of science and centres having sufficient competence to engage countries and regions strategically in a path of innovative growth, building on newly developed capabilities. This could help countries and regions that are lagging behind in terms of research and innovation performance reclaim their competitive position in the global value chains. Teaming will address this challenge by creating or upgrading such centres of excellence, building on partnerships between leading scientific institutions and low performing partners that display the willingness to engage together for this purpose.'

The WIDESPREAD-1-2014 call therefore looked for projects able to lead to the creation of new (or significant upgrades of existing) centres of excellence in member states and regions currently identified as low performers in terms of research and innovation, increasing on the one hand their scientific capabilities and on the other, enabling them to engage in a strategic growth path in terms of economic development. It is also expected that improved scientific capabilities will allow them to improve their chances to seek competitive funding in international fora (including the EU framework programmes).

'Over the medium to long term there will be a measurable and significant improvement in the research and innovation culture (as shown through indicators such as research intensity, innovation performance, enhanced strategy, values and attitudes towards research and innovation) within member states currently with low R&I performance. These will be fostered through constructive and sustainable partnerships achieved between research and innovation-intensive institutions of excellence and the partnering organisation in the low performing member state or region. Benefits will also accrue to the institutions from the more intensive research and innovation performers, in terms of issues such as access to new research avenues, creativity and the development of new approaches, as well as a source for increased mobility (inwards and outwards) of qualified scientists.'

Official photo from the conference "Spreading Excellence and Crossing Innovation Divide", November 23, 2016 , Brussels: (from left) Peter Plavčan (Ministry of Education, Science, Research and Sport of the Slovak Republic), Andris Sternbergs (coordinator of CAMART² project) and Carlos Moedas (Commissioner of Research, Science and Innovation)

Crossing the divide

In November 2016, during the conference 'Spreading Excellence and Crossing the Innovation Divide' organised by the European Commission in Brussels, Commissioner Moedas, together with the Director-General of the Directorate-General for Research and Innovation, Robert-Jan Smits, announced the winners of the WIDESPREAD 1-2014: Teaming competition.

At the event, Moedas argued that "one of the major political and economic challenges all countries are facing today is growing inequalities," adding that a lack of diffusion of knowledge and technologies is the cause. "The new digital technologies are not diffusing. The knowledge is trapped in businesses that are investing in innovation. This lack of diffusion feeds inequality, which has a huge cost for all of us. It translates into wasted resources, wasted talent and wasted potential," he said. "Research and innovation is key to overcoming these gaps. We need to feed the pipeline of talent and ideas and help them diffuse far and wide. Ensuring excellence is present in all EU member states. Encouraging openness so that knowledge, ideas and people will flow."

For Moedas, the answer as to why some countries get more impact from their spending on research than other countries (and he was referring to both scientific and economic impact) lies in the national research and innovation systems: "They vary widely. So one of the first challenges for countries with low levels of excellence is to introduce reforms to their systems. This is never easy. It requires a good diagnosis of the system. It requires a process to reach agreement between the different actors. And it requires expertise and persistence to implement reforms.

"Then, of course, there is the varying degree of investment. But the newer member states have been given a big opportunity to build excellence. The European Structural and Investment Funds are putting €100bn into research and innovation. But to make sure these resources actually translate into progress, countries will need to connect the islands of excellence and network internationally.

"And perhaps most important of all, countries need to attract talent. The best researchers and innovators are internationally mobile. If countries are not able to offer attractive opportunities, the most talented will leave," the commissioner concluded.

After discussing the role of Horizon 2020, Moedas then outlined his intention to "beef up and optimise investments in excellence." He said: "Teaming actions have had an enormous impact, supporting the creation of new or upgraded centres of excellence in widening countries.

CAMART²

One of the ten projects to receive funding through the WIDESPREAD 1-2014: Teaming competition was CAMART², the biggest project in the history of Latvian science to date. This was launched at a ceremony attended by representatives of the European Commission, Latvian government officials, foreign co-operation partners and guests, as well as the orchestrators of the project, i.e. the employees of the Institute of Solid State Physics. The objective of the project is to strengthen the position of both the institute and the Latvian state within the European science sector through the development of the centre into a regional institution of European renown in the field of materials science and technology transfer.

Speaking at the launch, Robert-Jan Smits said: "The only way Europe can compete with the rest of the world is to be smarter than others and to prove itself in the field of innovation. This means that investments must be made in education, science and innovation development. Such investments must be made at national level, at regional level, and, of course, also at international level within the European Union. We are delighted to see that, in the face of stiff competition, this major project has been awarded not only Horizon 2020 funding, but has also received support from the Latvian government.

"The strengths of the CAMART² project are the high qualifications of the scientists involved and a strong plan for how to pass on this knowledge and experience, and how to encourage mutual collaboration between the academic and business sectors. This project has all the characteristics required to make it an exemplar: high level science, potential for innovation, the business sector, new enterprises, and powerful partnerships, as well as a convincing management structure, which is absolutely vital for a project of this scale."

The project will facilitate the formation of a more comprehensive innovation and technology transfer ecosystem in the realm of research into modern materials and the use of such materials in innovative products, thus paving the way for the launch of new advanced technology and high added value manufacturing companies – an effort which epitomises the ends for which Teaming was established.

Robert-Jan Smits, Director-General of the Directorate-General for Research and Innovation at the CAMART² project kick-off meeting in Riga, Latvia, February 20, 2017

ISSP UL – a Trans-Baltic Hub for the Advanced Materials Research and Technology Transfer

Institute of Solid State Physics, University of Latvia (ISSP UL) is an independent legal entity founded by the University of Latvia. It is an internationally recognised leader in the materials sciences and cross-disciplinary topics in the Baltic States, providing internationally competitive research and innovative solutions for industrial applications.

ISSP UL was awarded the European Commission Centre of Excellence entitled "Excellence Centre of Advanced Material Research and Technology" (CAMART) in year 2001. This position was strengthened in 2017, when ISSP UL was the first research organisation in the Baltic Sea region receiving funding for the implementation of the project CAMART²: "Excellence Centre of Advanced Material Research and Technology Transfer".

The support from the EC as well as Cabinet of Ministers of Republic of Latvia, Ministry of Education and Science, and Ministry of Economics has provided an opportunity for ISSP UL to become a Trans-Baltic hub for the rising scientific excellence, boosting technology transfer and starting innovation along Riga-Stockholm axis and beyond.

Three foundation pillars of the Institute's growth are advanced science, modern education and innovation. In a close collaboration with the project partners from Sweden – Royal Institute of Technology (KTH) and Research Institutes of Sweden (RISE) – some crucial improvements from the development perspective have already been reached.

In science

RESEARCH STRATEGY

ISSP UL four priority research fields have been strategically established for increasing strong international scientific capacity and representing most current trends of material science, reflecting development in terms of scientific results, available infrastructure, and ongoing collaboration with scientific organisations and industry.

1 Theoretical and experimental studies of materials structure and properties

Fundamental principles and technology of multifunctional materials, computational modelling of materials and devices. Novel theoretical and experimental tools combined with computer simulations to predict crystallographic structures. Quantum chemistry and molecular dynamics study of fine structural effects and mesoscopic modelling to study structural, electronic, magnetic and optical properties.

2 Nanotechnology, thin films, nanomaterials and ceramics

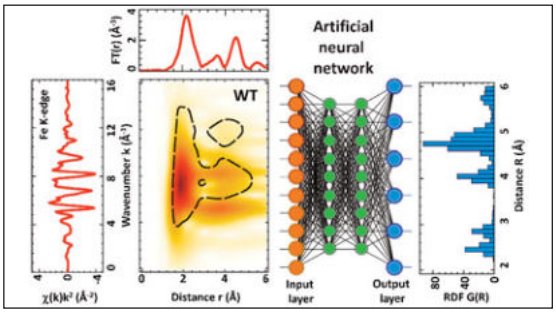
Novel nanomaterials and nanostructures, crystals, glasses, nanoceramics, polymer nanocomposites, and hybrid structures. These activities address the so-called Green Thin Film Nanotechnologies based on vacuum technologies such as physical and chemical vapour deposition, pulsed laser deposition as well as organic and inorganic spray wet technologies and original high power impulse magnetron sputtering technology.

3 Functional materials for photonics, sensorics and electronics

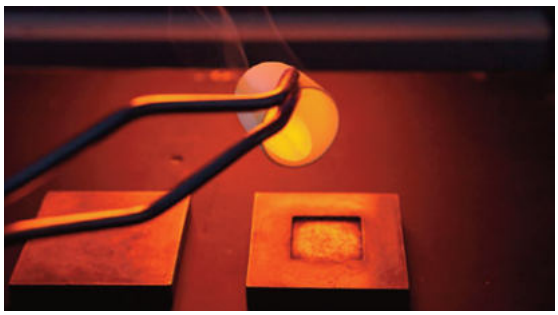
New materials for light emitters, lasers and OLEDs, waveguides and IR sensors, transparent nanocomposite oxyfluoride materials for optical applications, nanostructured up-conversion luminescent environmental sensors, materials for photonic applications, oxide based optoelectronics devices, large area nanocoatings for transparent and flexible electronics. Dosimeters and sensors using thermoluminescence and optical stimulated luminescence in nitrides and oxides, scintillators for high-energy physics and biomarkers for medical applications, low temperature persistent phosphors sensors.

4 Materials for energy harvesting and storage

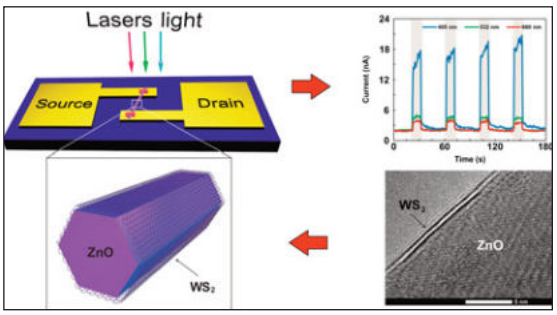
Fuel cells, photovoltaics, thin film batteries, lithium and potassium ion batteries, supercapacitors, piezoelectric energy harvesters, lead free ferroelectric perovskites, ferroelectric ceramics for electromechanical actuators and energy harvesting. Hydrogen generation, hydrogen and sustainable energy storage technologies with lower environmental footprint, thermoelectric, advanced functional and constructive materials for thermonuclear fusion.



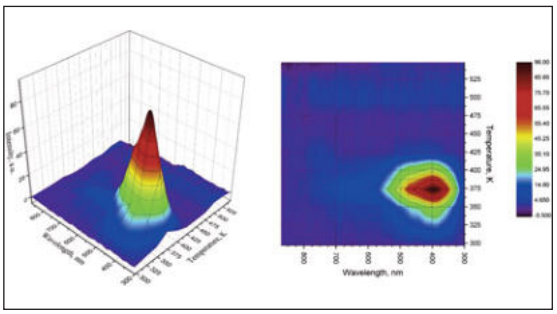
High-temperature X-ray absorption spectroscopy study of thermochromic copper molybdate. The reverse Monte-Carlo method was employed to perform accurate simulations of EXAFS spectra allowing to determine structural models being consistent with the experimental EXAFS data. For details see: I. Jonane et.al. Acta Materialia 179 (2019) 26-35



Synthesis and EPR studies of glass ceramics. The results of recent EPR spectroscopy studies in the field of glass ceramics are presented. For details see: A. Antuzevics et.al. Experimental Methods in the Physical Sciences 50 (2019) 161-190



Fast-Response Single-Nanowire Photodetector Based on ZnO/WS_2 Core/Shell Heterostructures. Schematic of ZnO/WS_2 core/shell nanowire-based photodetector For details see: E. Butanovs et.al. ACS Appl. Mater. Interfaces 10 (2018) 13869-13876.



X-ray induced defects in advanced lithium orthosilicate pebbles with additions of lithium metatitanate. Advanced lithium orthosilicate pebbles with additions of lithium metatitanate have attracted international attention as an alternative solid-state candidate for the tritium breeding in future nuclear fusion reactors. For details see: J. Cipa et.al. Fusion Engineering and Design 143 (2019) 10-15

INFRASTRUCTURE DEVELOPMENT

AN important part of the CAMART² project and growth of ISSP UL is Infrastructure development and investment plan that is established according to the research activities, innovation projects and related industry needs. Presently this plan is supported by European Research and Development Funds (ERDF) and national funding with more than 16 MEUR. The plan foresees that the infrastructure upgrade at ISSP UL will be synchronised with the KTH/RISE in a way that specific tools and necessary competences are established at ISSP UL but utilised by everyone through an open access agreement.

Up to now following equipment are installed and put in service: table top x-ray diffractometer, differential scanning calorimetry-thermogravimetry DSC-DTG system, Raman spectrometer, universal measurement spectrophotometer, spectral ellipsometer, x-ray absorption spectrometer, electron paramagnetic resonance spectrometer, pyrolytic spray coating system, electron beam lithography, atomic layer deposition system, x-ray photoelectron spectroscopy, Ink-Jet Dimatix Materials Printer, wavelength tuneable laser system equipped with streak camera and others.

Based on the elaborated infrastructure development actions, most of ISSP UL facilities will become part of Open Access Laboratory (OAL) tools. Its organisation relies on the extensive experience of KTH's Electrum Lab, including routines for lab operations, choices of tools, and a model for co-operation with industry and scientific organisations for fulfilling the requirements for science, innovations and technology transfer. ISSP UL trough OAL offers access to state-of-the-art scientific and technological facilities for materials synthesis, small-scale device manufacturing, and a versatile characterisation laboratory with unique techniques and expertise for national and international research groups, academia and companies.

In education

Sustainability is highly dependent on the next generation, who will go on to take the mantle of scientific fervour and maintain it in unremitting research and continuous development. Education is identified as a key for development of the regional high-tech industry through the provision of well-educated, competent and skilled scientists, engineers, and entrepreneurs. Since its foundation, ISSP UL has been actively engaged in teaching at the bachelor, master and doctoral levels, with close links to scientific work at the Institute.

A great share of the diploma works defended at the University of Latvia is carried out here, and a number of scientists at ISSP UL are involved in the teaching and administration of the bachelor and master's programmes in physics. This engagement is of vital importance for the recruitment of students and young scientists to ISSP UL.

To enhance the throughput of students, in the frames of CAMART² an upgrade of the existing master's programme is undertaken in close collaboration with the University of Latvia, KTH researchers and professors. The courses have been accepted into the curriculum of the Department of Physics and in the first year have gained a great popularity among the students. The objectives of the modifications are elaborated to achieve scientific excellence of strategic relevance for ISSP UL and projected industrial needs. Hence, the compulsory part of the programme is modern, general, and comprehensive in order to attract students with different backgrounds in physics and with a broad interest range from science to development and innovation.

Optional courses are in line with the research priority directions of ISSP UL, comprising topics on materials science, nanotechnology, thin films, micro and nanoelectronics, and photonics. In addition, several courses related to the development of entrepreneurship and innovation skills are given a prominent role in the new master's programme.

Solar Cup - a race between cars, boats and planes powered by solar panels that are self designed and constructed by children from Latvian schools

Furthermore, a doctoral studies programme is being developed in a similar manner, involving ISSP UL and RISE scientists and professors from KTH. Both master's and doctoral programmes will be open to international students, implying that courses may also be taught in English.

Full elaborated course list:

- Materials physics and applications;
- Nanomaterials and nanotechnology;
- Solid state physics;
- Semiconductor physics and devices;
- Computational methods on materials research;
- Symmetry, crystallography, group theory;
- Microscopy and spectroscopy characterisation methods;
- Optical and magnetic spectroscopy;

- Electrical characterisation of materials;
- Micro and nanofabrication of electronic and photonic devices;
- Thin films and coatings;
- Synthesis, processing and applications of modern materials;
- Entrepreneurship skills development; and
- Scientific methodology.

Other important need for the scientific development in general is attracting the next generation of skilful and passionate young students to Science, Technology, Engineering and Maths (STEM) disciplines, encouraging school youth to study exact sciences and to continue their professional development both in academia and industry. Therefore, ISSP UL is actively participating in conferences and exhibitions devoted to school children and students on higher

education and research institutions, awarding student grants at ISSP UL, organising excursions for school children, and giving lectures at schools and during career days. More than 10 years the Institute has been organising a Solar Cup competition for school children and providing possibilities to carry out scientific projects for school children.

In innovation

Since 2017, using resources of CAMART², ISSP UL has implemented an innovation development system to translate the new knowledge coming from fundamental research into real innovation potential, thereby making it disruptive. A new approach was required to change the mind-set and realise that fundamental research should also be directed towards the technological needs and industrial challenges. These actions have resulted in a set of the application-driven missions starting from "search for new OLED emitter materials" ending with "co-development of a new thin film materials" with Schaeffler for catalyst applications in CO2EXIDE H2020 and "development of new deposition technology" with company Sidrabe.

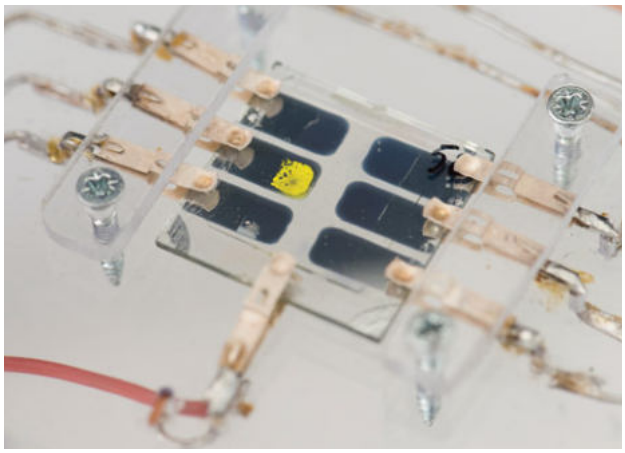
materize

To improve and develop co-operation with the industry in Latvia and abroad platform for collaboration with industry – Materize – was established. Materize is a single point of contact that provides both access to the expertise and resources of ISSP UL, as well as communication with companies in the language of business, and the implementation of projects in accordance with industry standards.

Within the framework of Materize, business-customer-tailored processes, clear information for the industry, and a simple approach to our competences and infrastructure have been created with the aim of making scientific achievements and services valuable for business.

Materize is providing ISSP UL scientific services in the following areas:

- Smart materials in electronics, photonics and sensor applications;
- Materials for energy production and storage;



- Thin film and coating technology;
- Modern methods of material characterisation;
- Theoretical modelling of materials;
- Development of demonstrators and prototypes; and
- Innovation development.

Currently the Institute has already gained experience in the co-operation with international market players in high-technology areas, such as GroGlass, Sidrabe, MassPortal, Baltic3D, LightGuideOptics International, EuroLCDs, CeramOptec, RD Alfa Microelectronics and others. These include such fields as anti-reflective glass, scientific and vacuum coating devices, 3D printing/additive manufacturing, fibre optics for high power applications, liquid crystal and 3D displays, and radiation resistive microelectronics.

It is planned that Materize will directly increase the export of ISSP UL's scientific and technological services and attract investment for the creation of new innovative companies in Latvia and support the development of the existing ones.

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CAMART²

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